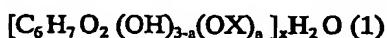


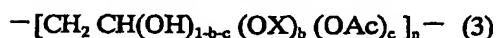
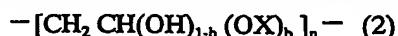
## CLAIMS

What is claimed is:

1. A cationic graft-copolymer of a water-soluble linear backbone polymer having hydroxyl groups, for a non-viral gene delivery vector, comprising a unit derived from a cationic water-soluble linear polysaccharide of the following formula (1)



or a unit derived from a water-soluble linear polyvinylalcohol of the following formula (2) or a partial hydrolyzed alcohol of the following formula (3)



Wherein X is a  $-(CH_2)_mR_1$  organic radical where  $R_1$  is a member of the class consisting of

$-NH_2$  radical,  $-N(CH_3)_2$  radical,  $-N(C_2H_5)_2$  radical,  $-N^+(C_2H_5)_3$  radical,

$-N^+(CH_2)_2CH_2CH(OH)CH_3$  radical,  $-N^+(C_2H_5)_2CH_2CH(OH)CH_3$  radical,

$-N^+(C_2H_5)_2(C_2H_5)N(C_2H_5)_2$  radical,  $-C_6H_4NH_2$  radical, and  $-COOC_6H_4NH_2$  radical,

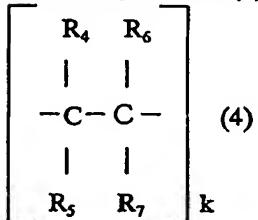
$-COR_2$  radical where  $R_2$  is  $-CH_2NH_2$  or  $-C_6H_4NH_2$ ,  $-CH_2CH(OH)CH_2R_3$  radical

where  $R_3$  is  $-NH_2$ ,  $-N(CH_3)_2$ ,  $-N(C_2H_5)_2$ , and  $-N^+(C_2H_5)_3$  radical, m is a natural

number of 1 to 3, a is a positive number having a value of  $0 < a < 3$ , b is a positive number

having a value of  $0 < b < 1$ , x and n are natural numbers having a value of 5 or more,  $1 > b+c$ ,

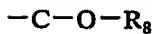
and Ac is acetyl radical; and a unit derived from a polymerize-able olefin compound of the following formula (4)



Wherein  $R_4$ ,  $R_5$  and  $R_6$  are each selected from the group consisting of hydrogen and  $CH_3$  and  $R_7$  is a member of the group consisting of

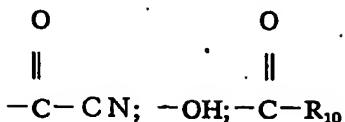
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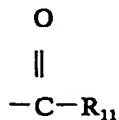


Where  $R_8$  is a member of the class consisting of hydrogen,  $C_1-C_{12}$  alkyl radicals, cyclohexyl radical,  $C_1-C_4$  hydroxyalkyl radicals,  $C_1-C_8$  aminoalkyl radicals,  $C_1-C_8$  dialkylaminoalkyl radicals, glycidyl radical, tetrahydrofuran radical,  $C_1-C_4$  lower alkyl-substituted tetrahydrofuran radical, benzyl radical, the  $(CH_2CH_2O)_yCH_2CH_2OH$  radical where y is a positive integer from 1 to 10, and  $-N(R_9)_2$  where the two  $R_9$ s which may be the same or different, are

either hydrogen or a C<sub>1</sub>—C<sub>4</sub> alkyl radical;

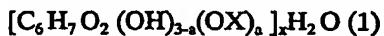


Where R<sub>10</sub> is a C<sub>1</sub>—C<sub>8</sub> alkyl radical; phenyl radical; tolyl radical; pyridine radical; pyrrolidone radical; and

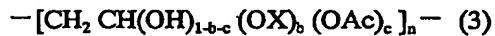
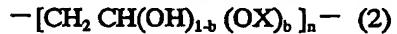


Where R<sub>11</sub> is NH<sub>2</sub>, NHCH<sub>3</sub>, N,N-dimethylamino radical, N,N-dimethylaminopropylamino radical, and morpholine radical.

2. A process for preparing a cationic graft-copolymer of a water-soluble linear backbone polymer having hydroxyl groups, for a non-viral gene delivery vector, which comprises reacting a cationic water-soluble linear polysaccharide of the following formula (1)

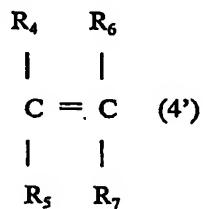


or a unit derived from a water-soluble linear polyvinylalcohol of the following formula (2) or a partial hydrolyzed alcohol of the following formula (3)



Wherein X is a -(CH<sub>2</sub>)<sub>m</sub>R<sub>1</sub> organic radical where R<sub>1</sub> is a member of the class consisting of

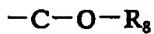
—NH<sub>2</sub> radical, —N(CH<sub>3</sub>)<sub>2</sub> radical, —N(C<sub>2</sub>H<sub>5</sub>)<sub>2</sub> radical, —N<sup>+</sup>(C<sub>2</sub>H<sub>5</sub>)<sub>3</sub> radical,  
 —N<sup>+(CH\_2)\_2CH\_2CH(OH)CH\_3</sup> radical, —N<sup>+(C\_2H\_5)\_2CH\_2CH(OH)CH\_3</sup> radical,  
 —N<sup>+(C\_2H\_5)\_2(C\_2H\_5)N(C\_2H\_5)\_2</sup> radical, —C<sub>6</sub>H<sub>4</sub>NH<sub>2</sub> radical, and —COC<sub>6</sub>H<sub>4</sub>NH<sub>2</sub> radical,  
 —COR<sub>2</sub> radical where R<sub>2</sub> is —CH<sub>2</sub>NH<sub>2</sub> or —C<sub>6</sub>H<sub>4</sub>NH<sub>2</sub>, —CH<sub>2</sub>CH(OH)CH<sub>2</sub>R<sub>3</sub> radical where  
 R<sub>3</sub> is —NH<sub>2</sub>, —N(CH<sub>3</sub>)<sub>2</sub>, —N(C<sub>2</sub>H<sub>5</sub>)<sub>2</sub>, and —N<sup>+(C\_2H\_5)\_3</sup> radical, m is a natural number of 1 to  
 3, a is a positive number having a value of 0<a<3, b is a positive number having a value of  
 0<b<1, x and n are natural numbers having a value of 5 or more, 1>b+c, and Ac is acetyl  
 radical; with a polymerize-able olefin compound of the formula (4')



Wherein R<sub>4</sub>, R<sub>5</sub> and R<sub>6</sub> are each selected from the group consisting of hydrogen and CH<sub>3</sub>

and R<sub>7</sub> is a member of the group consisting of

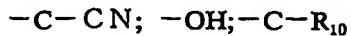


$$\parallel$$


Where R<sub>8</sub> is a member of the class consisting of hydrogen, C<sub>1</sub> – C<sub>12</sub> alkyl radicals, cyclohexyl radical, C<sub>1</sub> – C<sub>4</sub> hydroxyalkyl radicals, C<sub>1</sub> – C<sub>8</sub> aminoalkyl radicals, C<sub>1</sub> – C<sub>8</sub> dialkylaminoalkyl radicals, glycidyl radical, tetrahydrofuran radical, C<sub>1</sub> – C<sub>4</sub> lower alkyl -substituted tetrahydrofuran radical, benzyl radical, the (CH<sub>2</sub>CH<sub>2</sub>O)<sub>y</sub> CH<sub>2</sub>CH<sub>2</sub>OH radical where y is a positive integer from 1 to 10, and –N(R<sub>9</sub>)<sub>2</sub> where the two R<sub>9</sub>s which may be the same or different, are either hydrogen or a C<sub>1</sub> – C<sub>4</sub> alkyl radical;

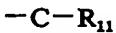


$$\parallel$$

$$\parallel$$


Where R<sub>10</sub> is a C<sub>1</sub> – C<sub>8</sub> alkyl radical; phenyl radical; tolyl radical; pyridine radical; pyrrolidone radical; and



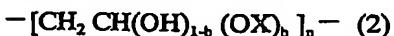
$$\parallel$$


Where R<sub>11</sub> is NH<sub>2</sub>, NHCH<sub>3</sub>, N,N-dimethylamino radical, N,N-dimethylaminopropylamino radical, and morpholine radical.

3. A complex between a cationic graft-copolymer of a water-soluble linear backbone polymer having hydroxyl groups and DNA, comprising a unit derived from a cationic water-soluble linear polysaccharide of the following formula (1)

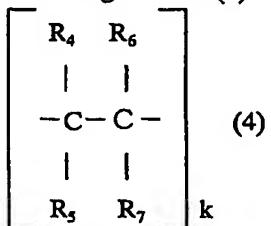


or a unit derived from a water-soluble linear polyvinylalcohol of the following formula (2) or a partial hydrolyzed alcohol of the following formula (3)

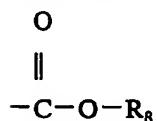


Wherein X is a -(CH<sub>2</sub>)<sub>m</sub>R<sub>1</sub> organic radical where R<sub>1</sub> is a member of the class consisting of –NH<sub>3</sub><sup>+</sup> radical, –NH<sup>+</sup>(CH<sub>3</sub>)<sub>2</sub> radical, –NH<sup>+</sup>(C<sub>2</sub>H<sub>5</sub>)<sub>2</sub> radical, –N<sup>+</sup>(C<sub>2</sub>H<sub>5</sub>)<sub>3</sub> radical, –N<sup>+(CH\_2)\_2CH\_2CH(OH)CH\_3 radical, –N<sup>+(C\_2H\_5)\_2CH\_2CH(OH)CH\_3 radical, –N<sup>+(C\_2H\_5)\_2(C\_2H\_5)N(C\_2H\_5)\_2 radical, –C<sub>6</sub>H<sub>4</sub>NH<sub>3</sub><sup>+</sup> radical, and –COC<sub>6</sub>H<sub>4</sub>NH<sub>3</sub><sup>+</sup> radical, –COR<sub>2</sub> radical where R<sub>2</sub> is –CH<sub>2</sub>NH<sub>3</sub><sup>+</sup> or –C<sub>6</sub>H<sub>4</sub>NH<sub>3</sub><sup>+</sup>, –CH<sub>2</sub>CH(OH)CH<sub>2</sub>R<sub>3</sub> radical</sup></sup></sup>

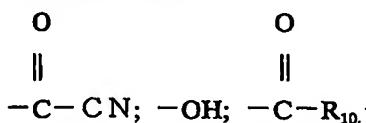
where  $R_3$  is  $-NH_3^+$ ,  $-NH^+(CH_3)_2$ ,  $-NH^+(C_2H_5)_2$ , and  $-N^+(C_2H_5)_3$  radical,  $m$  is a natural number of 1 to 3,  $a$  is a positive number having a value of  $0 < a < 3$ ,  $b$  is a positive number having a value of  $0 < b < 1$ ,  $x$  and  $n$  are natural numbers having a value of 5 or more,  $1 > b + c$ , and  $Ac$  is acetyl radical; a unit derived from a polymerize-able olefin compound of the following formula (4)



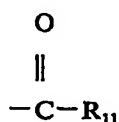
Wherein  $R_4$ ,  $R_5$  and  $R_6$  are each selected from the group consisting of hydrogen and  $CH_3$  and  $R_7$  is a member of the group consisting of



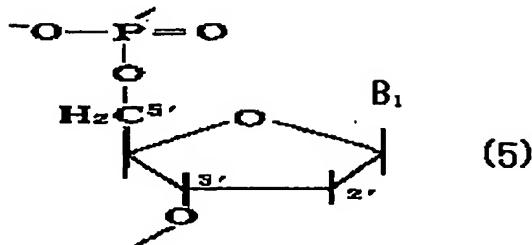
Where  $R_8$  is a member of the class consisting of hydrogen,  $C_1 - C_{12}$  alkyl radicals, cyclohexyl radical,  $C_1 - C_4$  hydroxyalkyl radicals,  $C_1 - C_8$  aminoalkyl radicals,  $C_1 - C_8$  dialkylaminoalkyl radicals, glycidyl radical, tetrahydrofuran radical,  $C_1 - C_4$  lower alkyl-substituted tetrahydrofuran radical, benzyl radical, the  $(CH_2CH_2O)_y$ ,  $CH_2CH_2OH$  radical where  $y$  is a positive integer from 1 to 10, and  $-N(R_9)_2$  where the two  $R_9$ 's which may be the same or different, are either hydrogen or a  $C_1 - C_4$  alkyl radical;



Where  $R_{10}$  is a  $C_1 - C_8$  alkyl radical; phenyl radical; tolyl radical; pyridine radical; pyrrolidone radical; and

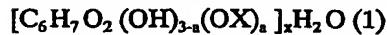


Where  $R_{11}$  is  $NH_2$ ,  $NHCH_3$ ,  $N,N$ -dimethylamino radical,  $N,N$ -dimethylaminopropylamino radical, and morpholine radical; and a unit derived from a poly(deoxyribonucleotide) of the following formula (5) as a recurring unit.

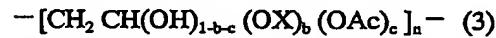
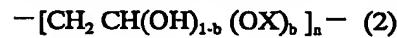


Where  $B_1$  is a base selected from the group of adenine, thymine, guanine, and cytosine.

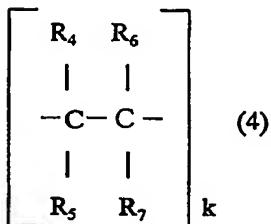
4. A complex between a cationic graft-copolymer of a water-soluble linear backbone polymer having hydroxyl groups and RNA, comprising a unit derived from a cationic water-soluble linear polysaccharide of the following formula (1)



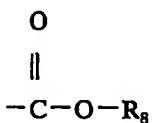
or a unit derived from a water-soluble linear polyvinylalcohol of the following formula (2) or a partial hydrolyzed alcohol of the following formula (3)



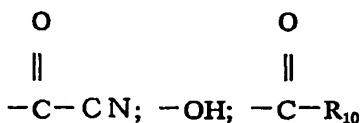
Wherein X is a  $-(CH_2)_m R_1$  organic radical where  $R_1$  is a member of the class consisting of  $-NH_3^+$  radical,  $-NH^+(CH_3)_2$  radical,  $-NH^+(C_2H_5)_2$  radical,  $-N^+(C_2H_5)_3$  radical,  $-N^+(CH_2)_2CH_2CH(OH)CH_3$  radical,  $-N^+(C_2H_5)_2CH_2CH(OH)CH_3$  radical,  $-N^+(C_2H_5)_2(C_2H_5)N(C_2H_5)_2$  radical,  $-C_6H_4NH_3^+$  radical, and  $-CO-C_6H_4NH_3^+$  radical,  $-COR_2$  radical where  $R_2$  is  $-CH_2NH_3^+$  or  $-C_6H_4NH_3^+$ ,  $-CH_2CH(OH)CH_2R_3$  radical where  $R_3$  is  $-NH_3^+$ ,  $-NH^+(CH_3)_2$ ,  $-NH^+(C_2H_5)_2$ , and  $-N^+(C_2H_5)_3$  radical, m is a natural number of 1 to 3, a is a positive number having a value of  $0 < a < 3$ , b is a positive number having a value of  $0 < b < 1$ , x and n are natural numbers having a value of 5 or more,  $1 > b + c$ , and Ac is acetyl radical; a unit derived from a polymerizable olefin compound of the following formula (4)



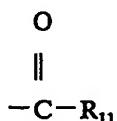
Wherein  $R_4$ ,  $R_5$  and  $R_6$  are each selected from the group consisting of hydrogen and  $CH_3$  and  $R_7$  is a member of the group consisting of



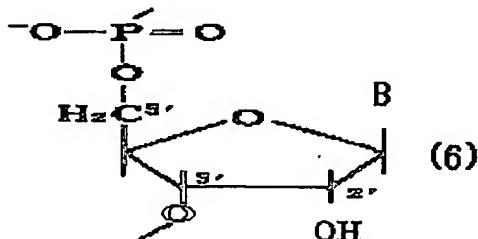
Where  $\text{R}_8$  is a member of the class consisting of hydrogen,  $\text{C}_1-\text{C}_{12}$  alkyl radicals, cyclohexyl radical;  $\text{C}_1-\text{C}_4$  hydroxyalkyl radicals,  $\text{C}_1-\text{C}_8$  aminoalkyl radicals,  $\text{C}_1-\text{C}_8$  dialkylaminoalkyl radicals, glycidyl radical, tetrahydrofuran radical,  $\text{C}_1-\text{C}_4$  lower alkyl -substituted tetrahydrofuran radical, benzyl radical, the  $(\text{CH}_2\text{CH}_2\text{O})_y\text{CH}_2\text{CH}_2\text{OH}$  radical where  $y$  is a positive integer from 1 to 10, and  $-\text{N}(\text{R}_9)_2$  where the two  $\text{R}_9$ 's which may be the same or different, are either hydrogen or a  $\text{C}_1-\text{C}_4$  alkyl radical;



Where  $\text{R}_{10}$  is a  $\text{C}_1-\text{C}_8$  alkyl radical; phenyl radical; tolyl radical; pyridine radical; pyrrolidone radical; and



Where  $\text{R}_{11}$  is  $\text{NH}_2$ ,  $\text{NHCH}_3$ ,  $\text{N},\text{N}$ -dimethylamino radical,  $\text{N},\text{N}$ -dimethylaminopropylamino radical, and morpholine radical; and a unit derived from a poly(ribonucleotide) of the following formula(6) as a recurring unit.



Where B is a base selected from the group of adenine, uracil, guanine, and cytosine.

5. A gene delivery system using a complex between the cationic graft-copolymer and DNA, of Claim 3.
6. A gene delivery system using a complex between the cationic graft-copolymer and RNA, of Claim 4.